

RESERVOIR SITING INVESTIGATION

The purpose of this document is to provide a summary of the process used to identify and evaluate alternative reservoir sites within Cumberland County.

SUMMARY

Before arriving at selection of the Cobbs Creek Reservoir Project, an extensive process was undertaken to identify alternatives for providing water supply to Cumberland County and its regional partners. A two-phased screening analysis of 25 potential reservoir alternatives within Cumberland County was conducted. Level A screening involved identification and evaluation of 25 potential alternatives based on reservoir size, existing land uses, affected wetland area, and degree of human disturbance. Based on evaluation of these criteria, 19 alternatives were eliminated from further analysis. The remaining 6 alternatives were carried through to a Level B screening analysis. These short-listed alternatives were evaluated with respect to reservoir storage volume, affected wetland areas, affected streams, existing structures, historic resources, transportation impacts, reservoir shoreline, safe yield and cost. Based on the results of the screening analysis it was determined that feasible reservoir alternatives were available to serve the needs of Cumberland County and its partners into the future. A number of possible James River withdrawal locations were also evaluated as part of this process.

The 6 short-listed alternatives varied greatly with respect to reservoir storage volume, safe yield, cost and aquatic impacts. In selecting Cobbs Creek as the preferred alternative, emphasis was placed on committed regional partnership (and its influence on required project size) and implementation issues (and their influence on permitting duration). With respect to committed regional partnership, the water supply needs of the Appomattox River Water Authority (ARWA) were also considered. Over a one-year period ending in December 2004, representatives of Cumberland County and ARWA held discussions to evaluate whether the public interest would be better served by building one large reservoir in Cumberland County rather than two smaller reservoirs in Cumberland and Amelia counties. The alternatives analysis indicated that the construction of two separate, smaller projects would have considerably less cumulative wetland and other environmental impact than one large project within Cumberland County to serve the combined needs of ARWA and Cumberland and its partners. Consequently, in December 2004, representatives of ARWA and Cumberland County notified VDEQ that the two regional bodies were electing to advance their respective smaller projects without giving further consideration to one large reservoir project to serve their combined needs. A December 15, 2004 letter from VDEQ Director Burnley acknowledges this decision and its consistency with the State's developing water supply planning process (see attached letter).

Once Cumberland County and its partners selected Cobbs Creek as the preferred reservoir site, more detailed engineering and environmental analyses of the preferred alternative were conducted and results from those analyses are presented in other sections of this Joint Permit Application.

POTENTIAL RESERVOIR SITE LOCATIONS

Through safe yield and James River flow augmentation analyses it was determined that the selected alternative should include at least 14 billion gallons (BG) of storage to assure that future water supply needs can be met while meeting James River flow requirements. With adequate James River withdrawal capacity, this storage volume can provide a safe yield benefit of about 50 million gallons per day (mgd).

Possible reservoir site locations within Cumberland County that could potentially meet desired storage volume criteria were identified through review of USGS topographic maps of Cumberland County and Virginia Geographic Information Net (VGIN) aerial photography (Commonwealth of Virginia, 2002). Potential reservoir sites were identified along streams within Cumberland County which drain to the James River above Richmond. Potential dam sites were identified on these streams which could be used to impound large volumes of water. Estimated reservoir pool elevations were made through review of topographic mapping.

This analysis resulted in the identification of 25 potential reservoir sites with dam locations within Cumberland County. These sites are identified in **Figure 1**.

Specific screening criteria were used as a means to compare and contrast the 25 potential reservoir sites. This screening process was accomplished using a two-phased approach as described below.

LEVEL A RESERVOIR SITE SCREENING ANALYSIS

A Level A screening analysis was first conducted and consisted of semi-quantitative estimations of location feasibility. Level A criteria included:

- Reservoir surface areas
- Existing land uses
- Total wetland acreage
- Human impacts

Reservoir Surface Areas

For the Level A analysis, reservoir surface areas were estimated by digitizing the proposed reservoir surface elevation for each alternative from USGS 1:24,000 scale base maps. As discussed above, it is recommended that a reservoir alternative or combination of alternatives be identified to provide, at a minimum, about 14 BG of storage. It is assumed that to provide this storage, a reservoir must have a minimum surface area on the order of 1,200 acres. Assuming that a maximum of two reservoir sites could be implemented, all alternatives with less than 600 acres were eliminated from further analysis.



Existing Land Uses

Existing land uses were identified through review of U.S. Geological Survey (USGS) topographic maps and VGIN aerial photography of the potential reservoir areas. Any prospective site with a current land use that would limit the use of the area for an impoundment was eliminated from further analysis. Two such sites were identified. The proposed Bigger Creek and Lower Reynolds Creek sites would have significant portions located within the Cumberland State Forest. This land is currently owned by the Commonwealth of Virginia. The existing use of this land and its current ownership could result in significant implementation issues for these alternatives. For these reasons, the Bigger Creek and Lower Reynolds Creek sites were removed from further analysis.

The Randolph Creek reservoir site would largely be located within Buckingham County (approximately 80 percent of the total footprint). While this does not preclude the Randolph Creek site for further analysis, ownership of this land must also be considered in the evaluation.

Total Wetland Acreage

Estimates of total wetland acreage within the proposed reservoir footprint for each alternative were made based on review of U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) digital maps for Cumberland County. Total wetland acreage inundated as a percentage of the total reservoir acreage was then calculated for each remaining alternative. Any alternatives with greater than 8 percent wetland acreage impacted were eliminated from further analysis. This breakpoint (i.e., 8 percent) allowed inclusion of reservoir sites with the smallest absolute wetland impact areas as well as some of the largest reservoir sites that still have a low percentage of site coverage by wetlands.

Human Impacts

Human impacts were also considered in the Level A evaluation. This was a qualitative analysis based on review of USGS topographic mapping and VGIN aerial photography. Based on this cursory evaluation, potential reservoir sites were given an impact value based on a scale of 1 through 5, with 1 being the lowest impact and 5 being the highest. The highest scoring alternative in the human impact analysis was the Maxey Mill Creek alternative. This configuration would result in the flooding of a portion of Route 60 in Cumberland County, which would require re-routing a major transportation route in the County, thereby causing an inconvenience to travelers along this route and reducing land development area along the County's major thoroughfare. As a result, this alternative was eliminated from further analysis.

Summary of Level A Screening

Table 1 provides a summary of the Level A criteria evaluation. As shown in this table, the Level A screening analysis eliminated 19 alternatives from further analysis. The remaining six (6) alternatives carried through into the Level B screening analysis were:

- Muddy Creek Reservoir Site
- Davis Creek Reservoir Site
- Cobbs Creek Reservoir Site
- Hooper Rock Creek Reservoir Site
- Oakwood Reservoir Site
- Deep Run Reservoir Site

LEVEL B RESERVOIR SITE SCREENING ANALYSIS

The six (6) short-listed alternatives remaining following the Level A screening were evaluated based on the following Level B criteria:

- Reservoir storage volume
- Affected wetlands by type
- Affected streams
- Existing structures
- Historic resources
- Transportation impacts
- Reservoir shoreline
- Safe yield
- Cost

The area of impact defined for the Level B screening was defined as the area which would be inundated by construction of the reservoir, which included the areas located within the normal pool area of each potential reservoir site.

Reservoir Storage Volume

Reservoir storage volume was estimated for each of the six (6) Level B alternatives. This value is calculated based on reservoir surface area estimates. In the Level A screening analysis, reservoir surface areas at the normal pool elevation were estimated by digitizing only the proposed reservoir surface elevation for each alternative from USGS 1:24,000 scale base maps. For the Level B analysis, the normal pool elevations were decreased by 10 feet (except for Hooper Rock Creek) to account for the embankment crest elevations being 10 feet higher than the normal pool elevations. A more detailed analysis based on more accurate elevation data was also conducted as part of Level B. Surface area elevations for each 10-foot elevation at the reservoir sites were taken from VGIN aerial photos with Digital Elevation Models (DEMs). These data were used to estimate the volume of water within each 10-

TABLE 1
LEVEL A SCREENING EVALUATION

Reservoir	Total Acreage	Wetland Acreage ¹	% Wetlands ²	Human Impact ⁵	Comment
Muddy Creek	3,970	221	5.6	3	Short Listed
Davis Creek	2,490	177	7.1	3	Short Listed
Cobbs Creek	1,190	1	0.1 ³	2	Short Listed
Deep Run	910	21	2.3	4	Short Listed
Creek southeast of Oakwood Church	730	10	1.3	2	Short Listed
Hooper Rock Creek	690	21	3.1	2	Short Listed
Maxey Mill Creek	3,230	167	5.2	4	Highway 60 Flooding ⁶
Cattail Creek	920	77	8.4	4	Significant Wetlands
Deep Creek	1,340	121	9.0	3	Significant Wetlands
Randolph Creek	6,520	522	9.5	4	Significant Wetlands ⁴
Wilks River at Lakeside Village	6,120	3465	56.6	3	Significant Wetlands
Wilks River at Trents Mill	1,220	888	71.2	2	Significant Wetlands
Lower Reynolds Creek	1,130			2	State Forest
Bigger Creek	680			1	State Forest
Upper Reynolds Creek	580			1	Too Small
Buck and Game Creek	540			2	Too Small
Creek north of Whiteville	470			3	Too Small
Bonbrook Creek	390			1	Too Small
Snowquarter Creek	340			1	Too Small
Creek near Pleasant View Church	280			1	Too Small
Creek near Duncan's Store	280			2	Too Small
Boston Branch	260			2	Too Small
Punch Creek	230			2	Too Small
Horn Quarter Creek	140			1	Too Small
Creek southeast of Little Fork Church	120			2	Too Small

Methods:

- Reservoir surface areas were estimated by digitizing the proposed reservoir surface elevation for each alternative from USGS 1:24,000 scale base maps
- Wetland acreages based on most recently available National Wetland Inventory coverages for Cumberland County obtained from US Fish & Wildlife Service (<http://www.nwi.fws.gov/>)
- Human Impact values are based on a visual inspection of VGIN aerial photography

Notes:

- 1 - Wetland acreage impacted within reservoir pool area
- 2 - Wetland acreage as a percentage of the total acreage
- 3 - Cobbs Creek also contains approximately 0.4 miles of riparian (linear) wetlands
- 4 - Approximately 80% of of the Randolph Creek footprint @ 350 ft msl is within Buckingham County
- 5 - Human Impact values are based on a scale of 1-5, where 1 is low and 5 is high
- 6 - Approximately 0.8 miles of Highway 60 would be flooded by a Maxey Mill Creek dam at 350 ft msl

foot elevation. Using this methodology, the revised dimensions for the Level B alternatives are presented in **Table 2**.

Table 2

Reservoir Dimensions ¹

Reservoir Alternative	Reservoir Surface Elevation (msl)	Reservoir Surface Area (acres)	Reservoir Storage Volume (BG)
Muddy Creek	340	3,627	44.4
Davis Creek	340	2,217	23.9
Cobbs Creek	340	1,108	15.0
Hooper Rock Creek	300	728	8.9
Oakwood	290	632	5.7
Deep Run	290	724	5.7

- 1 The reservoir dimensions presented in Table 2 differ from those presented for Level A (Figure 1). These Level B estimates are based on a more refined method of analysis than was conducted for Level A.

There was a wide variance in reservoir storage volumes of the Level B alternatives: from 5.7 to 44.4 BG. As described previously, a storage volume of at least 14 BG or more is recommended. This criteria could be met by a single project with a larger storage volume, or through a combination of two smaller projects.

Affected Wetlands

In the Level A analysis, total wetland acreage impacted at each reservoir site was estimated. For each of the Level B alternatives, the wetland acreage impacted by wetland type was estimated based on review of the USFWS NWI digital data for Cumberland County. In our experience, NWI mapping typically underestimates the amount of wetland area that is found during detailed field delineations. Nevertheless, the NWI mapping is adequate for comparing the relative magnitude of impact for the various short-listed sites. The acreages of each wetland type located within the reservoir footprint of each potential reservoir site were also calculated. No riverine wetlands were identified at any of the Level B sites. Wetland acreages impacted, defined by wetland type, are presented in **Table 3**.

Table 3

Affected Wetlands by Type (Based on NWI Mapping)

Reservoir Alternative	Lacustrine	Palustrine				Totals
		Emergent	Forested	Scrub- Shrub	Unconsolidated Bottom	
Muddy Creek	23.9	16.5	149.5	23.1	7.9	221
Davis Creek	0	0.6	165.4	2.0	9.2	177
Cobbs Creek	0	0	0	0	0.7	0.7
Hooper Rock Creek	0	0	6.9	0	14.4	21
Oakwood	0	0	6.7	0	3.0	9.8
Deep Run	0	0	18.3	0	2.5	21

This preliminary wetland investigation indicated a wide range of wetland impact values for the six short-listed alternatives. The largest impact to wetlands, 221 acres, would occur at Muddy Creek, while less than 1 acre are shown on NWI mapping for the Cobbs Creek site. Impacts to wetlands at a chosen reservoir site will require mitigation. Therefore, the potential wetland impacts are very important considerations in selecting a preferred project alternative(s) and could have a significant impact on implementation schedule, as well as project cost.

Summary of Level B Screening

The results of the Level B screening analysis are summarized in **Table 4**. The Level B criteria are categorized and presented in four sub-categories: reservoir dimensions, wetland and stream impacts, sociologic impacts, and cost estimates. Some additional data not presented in the preceding Level B analysis were also included. For preliminary planning purposes, it was assumed that some type of buffer area might be established that would include all areas within the reservoir contour elevation 10 feet above the normal pool and at least 200 feet back from the normal pool. The value presented for the Normal Pool and Buffer Surface Area represents the total area of the reservoir footprint and proposed buffer area. The potential impacts associated with the short-listed alternatives and presented in Table 4 do not include impacts within the buffer area.

For comparison purposes, a cost per mgd of safe yield benefit was calculated and presented in Table 4. These values were developed to represent the cost effectiveness of each alternative.

Table 4 includes key information which Cumberland County and its partners used to aid in selecting their preferred Cobbs Creek Reservoir alternative. The framework for that decision involved to a large extent regional partners and implementation issues. First, the number of regional partners involved in the Reservoir Project Development Plan heavily influences the water supply needs that must be met by a project. Second, the types and magnitude of implementation issues that would arise for any selected project must be carefully considered, because these will affect the length of time required to implement a

TABLE 4
SCREENING MATRIX FOR DECISION MAKING

CRITERIA			UNITS	Muddy Creek	Davis Creek	Cobbs Creek	Hooper Rock Creek	Oakwood	Deep Run
CRITERIA	Reservoir Dimensions	Safe Yield (SY)	(mgd)	92.5	76.2	53.7	33.6	25.2	25.2
		Pump Station Capacity	(mgd)	200	200	150	100	100	100
		Normal Pool Surface Area	(acres)	3,627	2,217	1,108	728	632	724
		Normal Pool & Buffer Surface Area	(acres)	4,490	2,830	1,430	960	950	1,090
		Shoreline at Normal Pool Elevation	(miles)	38.4	25.9	14.4	10.5	13.1	14.6
		Volume at Normal Pool Elevation	(Billion Gallons)	44.4	23.9	15.0	8.9	5.7	5.7
	Wetlands/Streams	Wetlands	(acres)	221	177	1	21	10	21
		Impacted Streams (Perennial)	(miles)	4.5	2.5	0.6	1.2	0.7	1.4
		Impacted Streams (Intermittent)	(miles)	23.7	14.4	7.7	4.5	6.0	9.0
		Channel Distance to James	(miles)	9.3	6.0	0.9	0.5	5.2	3.1
	Sociologic	Existing Structures	(# structures)	30	18	5	11	17	15
		Historic Resources	(# sites)	3	0	8	2	1	0
		Inundated Roads	(miles)	3.2	1.4	0.0	0.04	0.2	0.5
		New Road Construction	(miles)	2.7	1.5	2.4	1.0	1.5	1.2
Cost	Total Cost	(\$)	330 million	250 million	170 million	100 million	105 million	110 million	
	Unit Cost	(\$/mgd of SY)	3.57 million	3.28 million	3.17 million	2.98 million	4.17 million	4.37 million	

given project. Each of the six (6) Level B alternatives is discussed below with respect to these important factors.

Muddy Creek

The Muddy Creek Reservoir alternative is the largest reservoir configuration that was considered. With an estimated safe yield benefit of 92.5 mgd, it has the potential to serve the needs of a large region well into the future. However, because of its size, it also has the greatest environmental impacts. This project would require the most environmental mitigation of all the alternatives, which is a very time-intensive and cost-intensive undertaking. In terms of cost effectiveness, the Muddy Creek Reservoir is rated in the middle of the range in comparison to the other alternatives with a cost of \$3.57 million per mgd of safe yield.

Davis Creek

The Davis Creek Reservoir alternative also has the potential to serve the needs of a large region with an estimated safe yield of 76.2 mgd. It also would require significant environmental mitigation to compensate for the potential impacts associated with the project. This would have the effect of increasing the implementation time and increasing project costs. The Davis Creek alternative also has utility conflicts associated with it that could affect time to implementation. This alternative is rated as the third most cost effective alternative at \$3.28 million per mgd of safe yield.

Cobbs Creek

The Cobbs Creek Reservoir alternative falls in the mid-range of projects in terms of safe yield. It could provide an estimated 53.7 mgd safe yield to serve regional needs. An attractive feature of this alternative is the lesser degree of environmental impact relative to the Muddy Creek and Davis Creek alternatives. Based on NWI mapping, only 1 acre of wetland impact is estimated. As a result, far less environmental mitigation would be required, which would likely lessen the time required to implement this alternative. The Cobbs Creek alternative does have associated utility conflicts. However, these issues have been examined and are not considered insurmountable (see attached letter from the Colonial Pipeline Company). This alternative is rated as the second most cost effective alternative with a cost per mgd of safe yield of \$3.17 million.

Hooper Rock Creek

The Hooper Rock Creek Reservoir alternative would provide an estimated 33.6 mgd safe yield to serve regional needs. As with the Cobbs Creek Reservoir site, it could be used individually to meet projected demands, or more likely, be combined with another reservoir alternative. This site has relatively low potential wetland impacts in comparison to the two largest alternatives (Muddy Creek and Davis Creek), but would still require mitigation to compensate for these impacts, which would affect implementation time. Utility conflicts at this site are relatively minor and not anticipated to significantly impact implementation. The Hooper Rock Creek alternative is rated as the most cost effective alternative with a cost per mgd of safe yield of \$2.98 million.

Oakwood and Deep Run

The Oakwood and Deep Run Reservoir alternatives are the smallest alternatives, with estimated safe yields of 25.2 mgd for each. It is expected that either of these alternatives would need to be combined with another larger project to provide sufficient safe yield to meet regional needs. Of the two, the Deep Run site has a greater wetland impact (21 acres) than the Oakwood site (10 acres). It is anticipated that

environmental mitigation associated with these impacts would affect the implementation time of these projects. Deep Run does have a utility conflict which would require further investigation. No major utility conflicts were observed for the Oakwood sites. These alternatives are rated as the least cost effective of the six, with costs per mgd of safe yield of \$4.17 million for Oakwood and \$4.37 million for Deep Run.



COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

Street address: 629 East Main Street, Richmond, Virginia 23219

Mailing address: P.O. Box 10009, Richmond, Virginia 23240

Fax (804) 698-4500 TDD (804) 698-4021

www.deq.state.va.us

W. Tayloe Murphy, Jr.
Secretary of Natural Resources

Robert G. Burnley
Director

(804) 698-4000
1-800-592-5482

December 15, 2004

Mr. David E. Evans
McGuireWoods LLP
One James Center
901 East Cary Street
Richmond, Virginia 21219-4030

Mr. John W. Daniel II
Troutman Sanders
1111 E. Main Street
PO Box 1122
Richmond, VA 23218 1122

Dear Dave and John:

I am writing this letter in response to your letter of December 6, 2004, regarding the November meeting we had on the above referenced projects. Your letter requested confirmation of how the proposed Local and Regional Water Supply Planning Regulation, 9 VAC 25-780-10, *et seq.* would apply to the two projects.

The proposed regulation anticipates the implementation of a local planning process that promotes regional water supply solutions and thoughtful analysis of the potential environmental impacts of developing alternative sources of water supply to meet local needs. Based on our November 1, 2004, meeting, we believe that the Authority and Cumberland County have taken reasonable steps to evaluate the potential alternatives for developing a large single regional project in lieu of the two separate projects. We understand that the decision to develop two projects rather than one single project was based primarily on your evaluation of relative wetland losses. We believe that reducing the scale of wetland impacts in this instance is significant and the two-project alternative appears to be consistent with the intent of the draft water supply planning regulation. We recognize that there continues to be some level of regional involvement in these smaller projects and encourage you to continue to foster additional participation as you develop these projects.

Thank you for keeping us informed of your progress and we look forward to working with you further as these projects progress.

Sincerely,

A handwritten signature in dark ink, appearing to read "Bob", written over a horizontal line.

Robert G. Burnley

c: Scott Kudlas
Ellen Gilinsky



Colonial Pipeline Company

Gerald A. Beck
Project Leader – General Projects

410-569-6201 Direct
410-569-6509 Fax

September 10, 2004

VIA FACSIMILE AND EMAIL

Darvin E. Satterwhite, Esq.
Cumberland County, Virginia

Mr. Satterwhite:

In response to your letter dated September 9th, 2004, regarding the proposed reservoir project contiguous to the James River and Cobbs Creek in Cumberland County, Virginia, we offer the following comments.

While Colonial cannot conclusively state that there is not a “fatal flaw” with relocating the existing pipelines at your proposed site there doesn’t appear to be a “fatal flaw” based on the information provided to date. It appears possible, though very expensive, to relocate the two petroleum pipelines within the subject parcel(s) or just outside of the parcel(s).

This high level assessment is based on the following assumptions.

1. An acceptable alternate route is located and obtained. We would need replacement easement in kind. Prior talks with your officers have indicated that you could utilize the powers of condemnation to acquire said easements for us.
2. All environmental permits can be obtained.
3. We would expect the project to be 100% reimbursable to Colonial Pipeline Company, for all costs, including but not limited to, engineering, permitting, materials, equipment, labor, surveying, inspection, etc.
4. We would expect a full set of engineering drawings from you of the proposed reservoir project. Said plans to be both plan and profile views.
5. Upon our receipt and review of your engineering drawings, we will submit an up-front preliminary engineering cost for your acceptance.
6. Upon our receipt of your check for the full amount of our anticipated preliminary engineering costs, we would determine if there was a fatal flaw, and if there is not, we would develop a relocation plan, which will include all expected costs associated with our construction activities. Said plan and cost proposal would be submitted to you for your acceptance.
7. A relocation of this magnitude cannot be accomplished readily. I would anticipate a minimum of one full year, from receipt of a check for the full amount of the estimated relocation costs (or some other payment agreement is reached), until we could initiate our construction relocation activities. It could take up to an additional year to relocate the pipelines.

Hopefully this brief response will answer most of your questions, and allow you to proceed with your presentation and decisions at your September 13th meeting. Colonial will continue to work with the county if it chooses to proceed with the development of its project.

Please feel free to contact me at the number listed above, or Buzz Lewandowski at 410-549-4128, if you have any other questions or concerns.

Sincerely,

Gerald Beck

C: Buzz Lewandowski